

**Amendments to the Claims:**

Please note that all claims currently pending and under consideration in the referenced application are shown below. Please enter these claims as amended. This listing of claims will replace all prior versions and listings of claims in the application.

Please cancel claim 19, 38 and 41 without prejudice or disclaimer.

Please amend claims 1, 5-18, 33-37, 39, 40, 42-46, 50 and 58 as set forth below.

**Listing of Claims:**

1. (Currently Amended) A method of converting one or more reactants to a desired end product, comprising:  
introducing a reactant stream at one end of an axial reactor;  
heating the reactant stream as the reactant stream flows axially through an injection line having a reduced diameter with respect to the axial reactor to produce turbulent flow and thereby thoroughly mix the reactant stream with a heating gas; and  
~~thoroughly mixing the reactant stream with a heating gas within the injection line;~~  
passing the thoroughly mixed reactant stream axially ~~from the injection line to a reactor chamber;~~  
through a reaction zone of the axial reactor, the reaction zone  
~~maintaining a volume defined by the reactor chamber maintained at a substantially uniform~~  
~~temperature as the thoroughly mixed reactant stream passes therethrough; and~~  
~~producing over the length of the reaction zone, wherein the axial reactor has a length and a~~  
~~temperature and is operated under conditions sufficient to effect heating of the reactant~~  
~~stream to a selected reaction temperature at which a desired end product stream is~~  
~~produced at a location adjacent the an outlet end of the axial reactor.~~

2. (Original) The method of claim 1, wherein the reactant stream comprises methane and the desired end product comprises acetylene.

3. (Original) The method of claim 1, wherein the reactant stream comprises methane

or carbon monoxide and the desired end product comprises hydrogen.

4. (Original) The method of claim 1, wherein the reactant stream comprises a titanium compound and the desired end product comprises titanium or titanium dioxide.

5. (Currently Amended) The method of claim 1, wherein ~~maintaining the reaction zone reactor chamber is maintained at a substantially uniform temperature includes forming the chamber to comprise by a hot wall surrounding the reaction zone, volume with the hot wall surrounded by an~~ and forming an insulating layer on an interior surface of the hot wall.

6. (Original) The method of claim 5, wherein ~~further comprising forming the insulating layer from comprises a material selected from the group consisting of carbon, boron nitride, zirconia, silicon carbide, and combinations thereof.~~

7. (Currently Amended) The method of claim 5, wherein the temperature of the reaction zone ~~within the reactor chamber~~ is maintained between about 1500°C and about 2500°C.

8. (Currently Amended) A method for thermal conversion of one or more reactants in a thermodynamically stable high temperature gaseous stream to a desired end product in the form of a gas or ultrafine solid particles, the method comprising the steps of:  
introducing a stream of plasma arc gas between electrodes of a plasma torch including at least one pair of electrodes positioned adjacent to an inlet end of an axial reactor chamber, the stream of plasma arc gas being introduced at a selected plasma gas flow rate while the electrodes are subjected to a selected plasma input power level to produce a plasma in a restricted diameter injection line that extends into the reactor chamber and toward an outlet end of the reactor chamber;  
~~forming a gaseous stream thoroughly mixing an incoming reactant stream into the plasma by injecting at least one reactant into the injection line and thoroughly mixing the reactant~~

~~into the plasma within the injection line; to produce the thorough mixing prior to~~  
~~introduction into the reactor chamber;~~  
~~introducing the gaseous stream into a reactor chamber;~~  
~~maintaining a volume defined by the reactor chamber maintained at a substantially uniform~~  
~~temperature as the thoroughly mixed stream passes therethrough;~~  
~~bringing the mixed reactant stream to an over the flow field for the reactions to reach equilibrium~~  
~~state;~~  
~~cooling the gaseous stream including passing the gaseous stream through exiting a nozzle at an~~  
~~the outlet end of the reactor chamber by reducing the velocity of the gaseous stream while~~  
~~removing heat energy at a rate sufficient to prevent increases in its kinetic temperature;~~  
~~and~~  
~~separating the desired end product products from gases remaining in the cooled gaseous stream.~~

9. (Currently Amended) The method of claim 8, wherein the ~~at least one or more~~  
~~reactants reactant~~ comprises methane and the desired end product comprises acetylene.

10. (Currently Amended) The method of claim 8, wherein the ~~at least one or more~~  
~~reactants reactant~~ comprises methane or carbon monoxide and the desired end product comprises  
hydrogen.

11. (Currently Amended) The method of claim 8, wherein the ~~at least one or more~~  
~~reactants reactant~~ comprises a titanium compound and the desired end product comprises  
titanium or titanium dioxide.

12. (Currently Amended) The method of claim 8, wherein ~~maintaining the reactor~~  
~~chamber comprises a reaction zone section, which is maintained at a substantially uniform~~  
~~temperature includes forming the reactor chamber to comprise by a hot wall surrounding the~~  
~~volume reaction zone, with the hot wall surrounded by and forming an insulating layer on an~~  
~~interior surface of the hot wall.~~

13. (Currently Amended) The method of claim 12, ~~further comprising wherein the insulating layer is surrounded by~~ surrounding the hot wall with a cooling layer to prevent degradation of the reaction chamber.

14. (Currently Amended) The method of claim 12, wherein the ~~forming an~~ insulating layer comprises ~~disposing a carbon layer on the interior surface of the hot wall and, wherein surrounding the hot wall with a~~ the cooling layer comprises ~~contact a surface of the hot wall with~~ a layer of cool water.

15. (Currently Amended) The method of claim 12, wherein the temperature of the reaction zone of ~~volume defined by the~~ reactor chamber is maintained between about 1500°C and about 2500°C.

16. (Currently Amended) The method of claim 12, wherein the temperature of the reaction zone ~~volume defined by the reactor chamber~~ is maintained between about 1700°C and ~~2000°~~2000°C.

17. (Currently Amended) The method of claim 12, wherein ~~cooling the gaseous stream includes passing the gaseous stream the reactants which have passed through the reaction zone are then cooled by directing the product stream thus produced through a coaxial convergent-divergent nozzle positioned in the outlet end of the reactor chamber to rapidly cool the product stream.~~

18. (Currently Amended) The method of claim 12, wherein ~~thoroughly mixing the reactant into the plasma within the injection line includes the injection line is maintained at a diameter to produce producing a turbulent flow of the at least one reactant and the plasma within the injection line and thorough mixing of the incoming plasma gases and the reactant stream and wherein the injection line is of a smaller diameter than the diameter of the reaction zone of the~~

reactor chamber.

19. (Cancelled)

Claims 20-32 (Cancelled)

33. (Currently Amended) A method for thermally converting one or more reactants in a thermodynamically stable high temperature gaseous stream to a desired end product in the form of a gas or ultrafine solid particles, the method comprising the steps of:  
introducing a reactant stream ~~into an axial reactor at an upstream from one end thereof of an axial reactor;~~  
heating the reactant stream as the reactant stream flows axially through an injection line;  
passing the reactant stream axially through a ~~volume defined by a reactor chamber reaction zone of the axial reactor;;~~  
~~maintaining the volume defined by the reactor chamber reaction zone maintained at a~~  
~~substantially uniform temperature; over the length of the reaction zone; wherein the axial reactor has a length and a temperature and is operated under conditions sufficient to effect heating of the reactant stream to a selected reaction temperature at which~~  
~~producing a stream containing the a desired product stream is produced at a location adjacent an~~  
~~outlet end of the axial reactor reactor chamber; and~~  
cooling and slowing the velocity of ~~stream containing the desired end product and remaining gaseous stream exiting from the reactor chamber.~~

34. (Currently Amended) The method of claim 33, wherein the injection line has a reduced diameter with respect to the axial reactor to produce further comprising producing a turbulent flow ~~within the injection line and thereby thoroughly mix mixing the reactant stream with a heating gas within the turbulent flow.~~

35. (Currently Amended) The method of claim 33, wherein ~~introducing a reactant stream includes providing the reactant stream before reaction or thermal decomposition thereof~~ comprises at least one reactant selected from the group consisting of titanium tetrachloride, vanadium tetrachloride, aluminum trichloride and natural gas.

36. (Currently Amended) The method of claim 33, further comprising ~~the step of separating the desired end product from the remaining gases in the cooled gaseous stream containing the desired end product.~~

37. (Currently Amended) The method of claim 33, further comprising ~~the step of providing a converging-diverging nozzle arranged coaxially with the outlet end of the reactor chamber to rapidly cool the gaseous stream containing the desired end product by converting thermal energy as a result of a adiabatic and isentropic expansion as the gaseous stream flows axially through the nozzle and minimizing back reactions, thereby retaining the desired end product within the flowing gaseous stream.~~

38. (Cancelled)

39. (Currently Amended) The method of claim 37, wherein the converging-diverging nozzle has a converging section and a diverging section respectively leading to and from a restrictive open throat, the diverging section of the nozzle ~~having a conical configuration with exhibiting~~ an included angle of less than about 35°.

40. (Currently Amended) The method of claim 37, ~~further comprising wherein the converging-diverging nozzle has a converging section with a high aspect ratio and is configured so that the gaseous stream accelerates rapidly accelerating the stream containing the desired end product into the nozzle throat while maintaining laminar flow thereof.~~

41. (Cancelled)

42. (Currently Amended) The method of claim 37, further comprising ~~the step of~~ controlling the residence time and reaction pressure of the ~~gaseous reactant stream within in the reactor chamber by configuring~~ selecting the size of a restrictive open throat within the nozzle to ~~exhibit a desired cross-sectional area as taken substantially transverse to any flow therethrough.~~

43. (Currently Amended) The method of claim 37, further comprising the step of subjecting the ~~gaseous stream containing the desired end product~~ to an ultra fast decrease in pressure by smoothly accelerating and expanding the moving ~~gaseous stream containing the desired end product~~ along the diverging section of the nozzle to further decrease its kinetic temperature and prevent undesired side or back reactions.

44. (Currently Amended) The method of claim 33, ~~wherein maintaining the volume defined by the reactor chamber at a substantially uniform temperature includes disposing further comprising a carbon layer on an interior surface of the reactor chamber surrounding the reaction zone, wherein the carbon layer minimizes radial temperature gradients.~~

45. (Currently Amended) The method of claim ~~33~~ 44, further comprising ~~a carbon layer surrounding the reaction zone reactor chamber with and a cooling layer surrounding the carbon layer, wherein the carbon layer and the cooling layer minimize radial temperature gradients.~~

46. (Currently Amended) A method of forming a metal, metal oxide or metal alloy from a metal-containing compound, the method comprising the steps of:  
providing a plasma formed from a gas comprising an inert gas, hydrogen, or a mixture thereof;  
providing a reagent or a reagent mixture, the reagent or reagent mixture comprising a gaseous or volatilized compound of a selected metal;  
thoroughly mixing the reagent or reagent mixture with the plasma ~~at a location upstream from an axial reactor chamber~~ to produce a reactant stream;

passing the reactant stream axially through ~~a reaction zone of the reactor chamber;~~  
~~maintaining the reactor chamber reaction zone maintained~~ at a substantially uniform temperature;  
~~over the length of the reaction zone, wherein the reactor has a length and a temperature~~  
~~and is operated under conditions sufficient to effect heating of the reactant stream to a~~  
~~selected reaction temperature at which a desired~~  
~~producing a product stream is produced~~ at a location adjacent an outlet end of the reactor  
~~chamber, the product stream including thereby forming an equilibrium mixture~~  
~~comprising the selected metal, metal or an oxide or metal alloy thereof, wherein the~~  
~~selected metal, metal oxide or metal alloy being thermodynamically stable at the reaction~~  
~~temperature;~~  
cooling the ~~gaseous product stream~~ exiting the outlet end of the reactor ~~chamber~~ by reducing the  
velocity of the ~~gaseous stream~~ while removing heat energy at a rate sufficient to prevent  
increases in its kinetic temperature; and  
separating ~~desired end products the metal, metal oxide or metal alloy~~ from gases remaining in the  
cooled ~~gaseous product stream~~.

47. (Withdrawn) The method of claim 46, wherein the gaseous or volatilized compound of the selected metal is a gaseous or volatilizable halide.

48. (Withdrawn) The method of claim 46, wherein the selected metal is titanium, vanadium, or aluminum.

49. (Withdrawn) The method of claim 46, wherein the compound of the selected metal is titanium tetrachloride, vanadium tetrachloride, or aluminum trichloride.

50. (Currently Amended) The method of claim 46, wherein the reagent or reagent mixture further comprises at least one additional reagent capable of reacting at the reaction substantially uniform temperature to form an such that the equilibrium mixture is formed to  
comprise comprising an the metal oxide or metal alloy of the selected metal.



51. (Withdrawn) The method of claim 46, wherein the method forms titanium metal, and the reagent or reagent mixture comprises titanium tetrachloride.

52. (Withdrawn) The method of claim 46, wherein the method forms vanadium metal, and the reagent or reagent mixture comprises vanadium tetrachloride.

53. (Withdrawn) The method of claim 46, wherein the method forms aluminum metal, and the reagent or reagent mixture comprises aluminum trichloride.

54. (Withdrawn) The method of claim 46, wherein the method forms an alloy of titanium and a second metal, and the reagent or reagent mixture comprises titanium chloride and a gaseous or volatilizable compound of the second metal.

55. (Withdrawn) The method of claim 54, wherein the second metal is vanadium.

56. (Original) The method of claim 46, wherein the method forms a metal oxide of the selected metal, and the reagent or reagent mixture further comprises oxygen.

57. (Previously Presented) The method of claim 46, wherein the method forms titanium dioxide, and the reagent or reagent mixture comprises titanium tetrachloride and oxygen.

58. (Currently Amended) A method of forming a desired product from a hydrocarbon, the method comprising the steps of:  
providing a plasma formed from a gas comprising an inert gas, hydrogen, or a mixture thereof;  
providing a reagent or a reagent mixture, the reagent or reagent mixture comprising gaseous or volatilized hydrocarbon;  
thoroughly mixing the reagent or reagent mixture with the plasma at a location upstream from an axial reactor chamber to produce a reactant stream;  
passing the reactant stream axially through a reaction zone of a volume defined by the reactor

~~chamber;~~

~~maintaining the volume defined by the reactor chamber reaction zone maintained at a substantially uniform temperature; over the length of the reaction zone, wherein the reactor has a length and a temperature and is operated under conditions sufficient to effect heating of the reactant stream to a selected reaction temperature at which a desired product stream is produced at a location adjacent an outlet end of the reactor, thereby forming a product stream including an equilibrium mixture comprising the desired product, the desired product being thermodynamically stable at the reaction temperature; and cooling the gaseous product stream as it exits exiting at the an outlet end of the reactor chamber by reducing the velocity of the gaseous stream while removing heat energy at a rate sufficient to prevent increases in its kinetic temperature; and separating the desired end product products from gases remaining in the cooled gaseous product stream.~~

59. (Original) The method of claim 58, wherein the reagent or reagent mixture comprises natural gas.

60. (Original) The method of claim 58, wherein the reagent or reagent mixture comprises methane.

61. (Withdrawn) The method of claim 58, wherein the desired product comprises acetylene.

Claims 62-87 (Cancelled)